Injury, Int. J. Care Injured 46 (2015) 2384–2388

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

# Displaced trochanteric fragments lead to poor functional outcome in pertrochanteric fractures treated by cephalomedullary nails

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ARTICLE INFO

*Article history:*
Accepted 29 June 2015

*Keywords:*
Hip fractures
Pertrochanteric fractures
Greater trochanter
Fragility fractures
Parker mobility score

ABSTRACT

*Background:* The importance of the greater trochanter and its attached abductor muscles for physiological gait is well accepted. However the influence of a displaced greater trochanter fracture after a pertrochanteric fracture is unknown. The aim of this study is to determine if there is an association between the greater trochanter position and the level of patient mobility following internal fixation of pertrochanteric fractures.
*Methods:* One hundred and thirty-three consecutive elderly patients with a median age of 85 (interquartile range [IQR] 79–91) years, who were treated for pertrochanteric fractures at a level I trauma centre, were recruited. AO 31 A3.1 and A3.2 fracture types were excluded from the statistical analysis. Patient mobility was prospectively assessed before the fracture and one year following fracture treatment using the Parker mobility score. In a multivariable analysis, the influence of a displaced greater trochanter on patient mobility at one-year follow-up was assessed. The analysis was adjusted for age, gender, body mass index, Charlson comorbidity index, AO fracture classification, varus-/valgus malposition of the neck-shaft fragments, and Parker mobility score before fracture.
*Results:* Post-operative X-rays were available in 125 patients, out of which 66 (53%) patients were identified with a displaced or migrated greater trochanter. One year mortality rate was 22% ($n = 27$). In the 82 patients who had functional assessment one year post-operatively, the median Parker mobility score before fracture and at one-year follow-up was 7 (IQR 4–9) and 7 (IQR 3–9) in patients without, and 7 (IQR 4–9) and 3 (IQR 2–5) in patients with a displaced greater trochanter. In multivariable analysis, a displaced greater trochanter was significantly associated with a lower Parker mobility score (−1.74, 95% confidence interval −2.37, −1.12, $p < 0.01$).
*Conclusion:* Greater trochanter displacement following internal fixation of extracapsular hip fractures with a cephalomedullary nail is associated with a poor functional outcome. Greater attention to achieve adequate reduction and stabilisation of this fragment during internal fixation of pertrochanteric hip fractures should be aimed for despite the inability of current cephalomedullary implants to do so.
*Level of evidence:* III prognostic and epidemiological study



## Background

The greater trochanter, as the insertion point for the abductor muscle, plays an important role in a normal gait. Several studies have highlighted the importance of restoration of the greater trochanter following osteotomy or in case of incidental fracture during total hip arthroplasty. Insufficient fixation or displacement of the relevant fragment results in abductor muscle weakness, pain and limping [1,2].

It is therefore remarkable that in pertrochanteric fracture management, the association between a displaced greater trochanter and impaired walking function has not been investigated so far.

In pertrochanteric fractures a posterior fracture fragment of the greater trochanter is often detectable on the lateral hip radiograph [Fig. 1a]. This fragment may occur in any pertrochanteric fracture type except in AO 31 A3.1 and A3.2 fractures. Depending on the size of the fragment and the entry point of the nail, which is often

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http://dx.doi.org/10.1016/j.injury.2015.06.040
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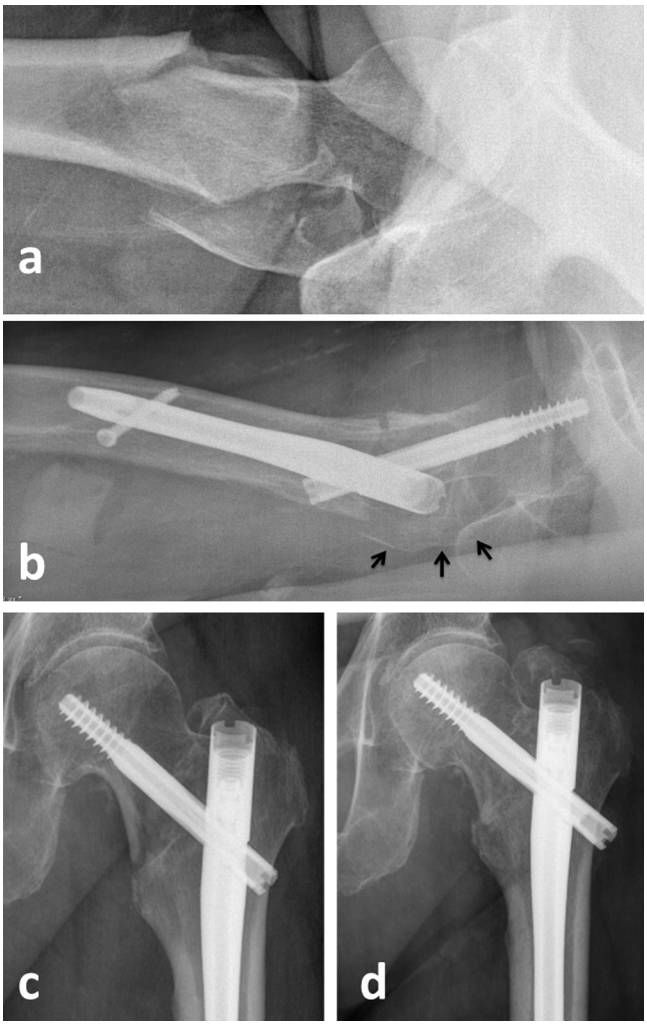


**Fig. 1.** (a) Lateral X-ray of the hip illustrating presence of a posterior fracture fragment of the greater trochanter, (b) postoperative lateral X-ray of the hip illustrating an inadequately fixed posterior fracture fragment after intramedullary nailing. Typical displacement pattern of the greater trochanter (c) postoperative and (d) after 6 weeks.

anterior to the fragment, adequate fixation of the fragment may not occur [Fig. 1b]. In the absence of adequate fixation, the posterior fracture segment typically appears to displace in a cranio-medial direction on AP views of the hip [Fig. 1c].

The aim of the present study is to investigate whether a displaced greater trochanter fragment in a pertrochanteric fracture following closed reduction and internal fixation with a cephalo-medullary locking nail affects the walking capabilities of a patient, as measured by the Parker mobility score [3]. We hypothesised that a displaced greater trochanter leads to a significant drop in mobility level.

## Patients and methods

We performed a retrospective analysis of prospectively recorded data in a single centre cohort study approved by the local ethical committee (Ref. Nr 131/13). From January 2011 to March 2012, 149 consecutive patients aged 65 years or older with a low-energy pertrochanteric fracture (AO 31A) presenting at the emergency department of a Level I trauma centre were evaluated for inclusion. Exclusion criteria were concomitant lower extremity fractures, pathologic fractures associated with tumours, previous proximal femur fractures or osteotomies of the proximal femur, and preexisting severe degenerative changes of both hips. AO 31 A3.1 and A3.2 fractures were included in the baseline data but excluded for statistical analysis for the reason mentioned above. Sixteen patients were excluded due to previous surgery or preexisting disease of the contralateral hip.

Age, gender, body mass index (BMI), Charlson comorbidity index (CCI) [4] and Parker mobility score [11] before the fracture were recorded. Median age of the remaining 133 patients was 85 (Interquartile range [IQR 79–91]) years, 105 (79%) were women. The baseline characteristics are shown in Table 1.

The diagnosis of a pertrochanteric fracture was confirmed by standard pelvic AP and lateral projection radiographs and classified according to the AO/OTA classification [5]. Approximately two thirds were type A2 fractures. Presence of a posterior fragment of the greater trochanter was determined using lateral hip radiographs. Stratifying the cohort by presence ($n = 69$) or absence ($n = 64$) of a posterior greater trochanter fragment shows no relevant differences across the baseline characteristics.

Functional outcome was assessed with the Parker mobility score.

All radiographs of each patient were independently analysed by two observers, blinded to mobility scores. Discrepancies were discussed until concordance was reached.

Radiological follow-up was performed postoperative, at 6 weeks, 3 months and one year postoperatively. Of the 133 patients included postoperative radiographs were available in 125 patients (3 patients died before surgery, 2 patients were treated by primary total hip arthroplasty, and in 3 patients no radiographs were available).

The following radiologic protocol was used to define a fragment displaced on all postoperative radiographs [Fig. 2]: On the AP view of the pelvis, the femoral long axis was drawn on both sides, as well as the horizontal teardrop line. The latter was then moved parallel to the tip of the greater trochanter of the non-injured side which created an intersection point with the lines marking the femoral long axis on both sides, thus dividing the proximal femurs into four quadrants. We defined the greater trochanter on the injured side as displaced or malunited if it was detectable in the upper inner quadrant. We decided the minimal size of the fragment visible to be at least equal to the size of the proximal nail diameter

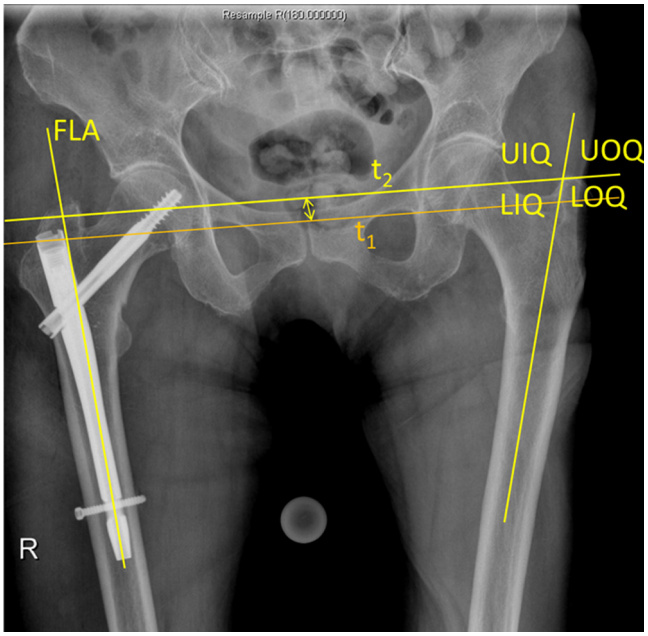


**Fig. 2.** FLA: femoral long axis, t1: teardrop line, t2: line parallel to t1 touching the tip of the greater trochanter of the uninjured side. UIQ: upper inner quadrant, UOQ: upper outer quadrant, LIQ: lower inner quadrant, LOQ: lower outer quadrant.